

M-74100



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CORNERSTONE 260™
MOTORIZED 1/4m MONOCHROMATOR
MODELS 74100 AND 74125

USER MANUAL

Please read these instructions completely before operating this equipment. The specification and operating instructions apply only to the model(s) covered by this manual. If there are any questions or problems regarding the use of this equipment, please contact Newport or the representative from whom this equipment was purchased.

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I. INTRODUCTION

In developing the Cornerstone 260™ we leveraged all that experience plus modern computer aided design to come up with a compact, inexpensive monochromator that has all the versatility required by our research customers. Even so, this new instrument packs the power of two gratings, filter wheel control, IEEE-488 and RS-232 or USB computer interfaces, and an integrated shutter built right into its compact housing; a perfect instrument for many OEM applications.

For your convenience, every Cornerstone™ comes with a simple utility program to run on your PC. You can get up and running within minutes of opening the box. For experimental tasks, or methods development, we offer a hand held controller which interfaces directly to the instrument. The 74009 hand controller allows you immediate access to all the instrument's functions without the need for any programming. For those repetitive processes, which are better done under computer control, the Cornerstone 260™ has an intuitive command set.

In keeping with our other monochromators, we offer a wide selection of gratings outfitted on the Cornerstone 260™'s kinematic, interchangeable grating turret. You can set a variety of bandwidths by choosing from our interchangeable fixed slits, multiple fixed slit assembly, or micrometer driven slits. Moreover, this instrument can be purged with dry nitrogen for work below the oxygen absorption cut-on at 180 nm.

The optical design of Cornerstone 260™ is based upon an out of plane version of the Ebert-Fastie monochromator. Newport has extensive experience with this design. The Cornerstone 260™ is an f/3.7 system with slightly asymmetric input and output focal lengths, 126 mm and 260 mm respectively. The 180 degree, in-line configuration of the optical ports makes it a snap to align your complete system or to mount the instrument on an optical bench or rail. Additionally, this compact design has a very small footprint so it requires little tabletop space.

For the Cornerstone 260™, we computer optimized this optical configuration to assure the highest resolution, greatest throughput, and the lowest stray light. Although the system is a fast f/3.7, the optimized design provides excellent stray light rejection while minimizing aberrations.

This manual applies to the **74100** Cornerstone 260, which has RS232 and GPIB communications interface, and the **74125** Cornerstone 260, which has a **USB** communications interface.

II. UNPACKING AND SETTING UP

IMPORTANT: *Do not connect any USB Cornerstone™ to the computer unless the USB driver has been installed, or until prompted to do so.*

Carefully unpack the Cornerstone™ monochromator and its accessories. The packaging is molded to your instrument and therefore provides optimal protection. You should save the packaging in case you ever need to transport or ship this instrument.

Your Cornerstone™ 260 comes completely assembled with up to two gratings installed. Your fixed slit housings, or micrometer driven slits, are mounted at our factory. The instrument is closed and the optical ports are covered to prevent contamination of the optics during shipment. Included with the Cornerstone™ you should also find:

1. this manual
2. a tabletop power supply (universal input)
3. a line cord for your country
4. any additional gratings you ordered
5. a CD-ROM containing your Cornerstone™ software

Since the Cornerstone™ is aligned and calibrated at our factory; there is no need to remove the top. You can get started immediately by connecting the 5 pin DIN connector of the power supply to the Cornerstone™ back panel, connect the line cord to both the power supply and the wall, and then turn on the Cornerstone™ power switch. You will hear the monochromator drive to its home position.

II.1. SOFTWARE INSTALLATION

Newport provides an elementary software package with your Cornerstone™ 260. To load and run the software you must have a PC compatible computer (with CDROM drive) running Microsoft Windows XP SP1 or above. For the 74125 a USB2 port is required. ***To successfully complete the Install of the CS260 USB driver or the Utility software you must have Administrator privileges on the PC which you are performing the install.***

The CD contains the installation for the Utility program, LabView VIs and the USB drivers. The Utility Program provides easy access to almost all Cornerstone™ functions and is discussed in Section VI CORNERSTONE™ UTILITY PROGRAM. Additionally, you can use the LabView VIs when writing your own LabView software for Cornerstone™ (National Instruments LabView required).

There are three versions of the basic Cornerstone™ software. The first version is for IEEE-488 communications. This version requires that you have a National Instruments IEEE-488 controller card and the corresponding software drivers installed in your PC. The second version is for RS-232 communications. There is also a USB version for Model 74125—the USB driver must be installed for that version to function (see §II.2, p. 6). In all cases, the software looks the same, and has the same functionality.

See the Table I below for where to find the Utility install program, the VIs and the USB drivers.

Table I (Cornerstone Utility CD 74100/74125 relevant directories)

	Directory on Utility CD	Sub-directory containing Install Program (Setup.exe) for the Utility application	Sub-directory containing LabView VIs
CS260 using RS232	\74100RS232\	\74100RS232\Utility\Installer	\74100RS232\
CS260 using GPIB	\74100GPIB\	\74100GPIB\Utility\Installer	\74100GPIB\
74125 CS260 USB	\74125\	\74125\ Utility\Installer	\74125\
74125 USB drivers and install file	\USB DRIVERS	--	--

II.2. UTILITY PROGRAM INSTALLATION

IMPORTANT: *Do not connect any USB Cornerstone™ to the computer unless the USB driver has been installed, or until prompted to do so.*

Note: If the Utility software will not be installed with USB Model 74125, please skip to §II.3, p. 7.

1. Put the Cornerstone™ CD-ROM into your computer drive.
2. Select Run... from the Windows Start Menu. Then click on the Browse...button. Now use the controls in the Browse dialog box to select the Cornerstone™ CD, browse to the folder for your instrument as shown in Table I above. Inside the folder you will find "Setup.exe". Double-click on this program and then press the OK button in the Run dialog box.
3. The Installation program will appear, follow the prompts to install the Utility software on you PC. The default directories and Start Menu groups will work on most machines and should be used if possible. This simplifies the installation as you only need to click the "Next" button a few times.
4. Another install program will run and you should be able to use the default values again. Simply click "Finish" to complete the installation.
5. *If using USB Model 74125, follow the connection procedure in §II.3, p. 7 starting at Step #6.*
6. You are now ready to work with the Cornerstone™. Please review the Safety section in detail before proceeding to the 15 Minute Basics.

<< IMPORTANT NOTE >>

For the software to send proper numeric format to the instrument, Windows Regional Settings in Control Panel must be set to English (United States).

II.3. DRIVER INSTALLATION FOR USB MODEL 74125

IMPORTANT: Do not connect any USB Cornerstone™ to the computer unless the USB driver has been installed, or until prompted to do so.

Note: If the monochromator(s) will be used with the optional TRACQ Basic™ software, follow its installation procedure now and disregard the remainder of this section.

Perform the following steps to install the USB driver for use with OEM or any other applications:

1. Log into a Windows user account *with Administrator privileges*.
2. Insert the Cornerstone™ CD-ROM into a CD or DVD drive and locate the USB drivers folder from Table I (§II.1, p. 5).
3. Right-click on the file "oriel_cs_usb.inf" and select the *Install* option from the pop-up context menu.

Note: If filename extensions are not displayed, two files will appear as "oriel_cs_usb". If the menu does not display the *Install* option for one file, use the other one.

4. If any warning dialogs appear stating that the driver is "not signed" or "has not passed Windows Logo testing", click "Continue Anyway" to proceed.
5. Driver installation will complete silently if successful.

Note: If an "Installation failed" dialog appears, the logged-in Windows user account may not have Administrator privileges required for installation. *Please consult with your system manager and repeat from Step #1 before contacting Newport/Oriel Customer Service.*

6. Power-on one Cornerstone™ monochromator, then connect its USB cable to the computer. *Do not connect any additional devices yet.*
7. When the "Found New Hardware" wizard appears, select the option "Install the software automatically (Recommended)", then click the "Next >" button. (It is not necessary to have the CD-ROM in the drive at this point.)
8. If any warning dialogs appear stating that the driver is "not signed" or "has not passed Windows Logo testing", click "Continue Anyway" to proceed.
9. After the wizard completes, click the "Finish" button.
10. Repeat from Step #6 for any additional monochromators.

Note: If a Cornerstone™ is connected to a different USB port on the same computer at a later time, it may be necessary to repeat installation Steps #7 through #9.

Note: With some computers it is necessary to let the Cornerstone™ power up and home with the USB disconnected, then connect the USB cable to the computer, then run the Monochromator Utility Software program.

III. SAFETY

Electrical

The Cornerstone™ requires only DC voltages for operation. These voltages are provided by an external power supply. This universal input power supply accepts 110/220 VAC for operation and has no user serviceable parts. Do not attempt to open the external power supply. Do not attempt to work in the Cornerstone™'s electrical compartment without first disconnecting the power cord, since you may contact live voltage areas inside the compartment even with the power switch in the "off" position.

Cornerstone™ has an internal microprocessor and should be installed with appropriate surge/EMI/RFI protection on all power lines. Dedicated power lines or line isolation may be required for some extremely noisy sites. The circuits used in Cornerstone™ are extremely sensitive to static electricity and radiated electromagnetic fields. Operation of Cornerstone™ close to intense pulsed sources (lasers, xenon strobes or arc lamps, etc.) may compromise performance, if shielding is inadequate, and may cause permanent damage to the microprocessor. Note: This instrument conforms to European CE standards for both safety and EMC.

Mechanical

Avoid dropping, sudden shocks, or rough handling of the monochromator since this may cause the system to lose its calibration and may destroy the high precision drive components or optics.

Do not use more than finger force in tightening down the grating mounts, since this may cause damage to the drive assembly.

Optical

Do not touch any optical surfaces since this is likely to cause irreparable damage. Do not attempt to clean any optical surface except by blowing off dust or lint particles with a stream of dry clean air or nitrogen.

IV. 15 MINUTE BASICS

IV.1. GETTING STARTED WITH THE HAND CONTROLLER

The 74009 Hand Controller is a fast and easy way to begin immediate communications with the Cornerstone™. Although the Hand Controller does not provide access to all the functions of this instrument, it does provide a simple interface to the most commonly used parameters and controls.

Physical Connections

Please note: None of the Cornerstone™ accessories are designed to be connected or disconnected with power on. Always turn off the instrument using the power switch on the back panel before you connect or remove the filter wheel or any communications cable (including the Hand Controller).

To get started with 74009 Hand Controller, simply connect the black communications cable by snapping the RJ-11 connector into the receptacle on top of the controller and snapping the other end into the matching connector on the back panel of your Cornerstone™.

Activating the Hand Controller

With the Hand Controller connected, turn on power to the Cornerstone™. You will see a horizontal cursor in the upper left corner of the display. Press the LOCAL key to activate communications through the Hand Controller. Please note that if the Hand Controller is active (the display is lit and information fills the screen), you cannot command the Cornerstone™ via either RS-232, IEEE-488 or USB. Press the LOCAL key again to deactivate the Hand Controller, allowing PC communications.

Yellow “Shifted” Keys

Some keys are divided into top and bottom halves. The function for the yellow top half is called a “shifted” function. To activate these commands press the SHIFT key in the bottom left corner and then press the function key.

Entering Parameters- the Numeric Keypad

Many of the Cornerstone™ commands require a numeric parameter. First press the function key for your command. The bottom line of the LCD display will then show an abbreviated form of the command and the current parameter. There is no need to erase this number; simply typing the first key for your desired parameter will overwrite the current value. To execute the command press the ENTER key in the bottom right corner.

While entering parameters, if you mistype one digit press SHIFT and then DEL (above the decimal point in the numeric keypad); this will move backward one display position and delete that character.

Key Reference (From top of the controller to the bottom, left to right)

ABORT-	If you accidentally press a function key or enter a bad parameter you may press the ABORT key to clear that command before it executes. The ABORT key has no effect on most functions once the command is executed (by pressing ENTER). However, wavelength motion will stop immediately upon ABORT and the display will update to show the wavelength where motion was halted.
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<i>STEP DOWN</i>	Press this key once to move the Cornerstone™ to shorter wavelengths by the smallest possible increment. Holding this key causes rapid single stepping toward lower wavelengths. Press SHIFT and then STEP DOWN, you can use the keypad to define a number of steps to move at once. Press ENTER to execute this larger move.
<i>STEP UP</i>	Press this key once to move the Cornerstone™ to higher wavelengths by the smallest possible increment. Holding this key causes rapid single stepping toward higher wavelengths. Press SHIFT and then STEP UP, you can use the keypad to define a number of steps to move at once. Press ENTER to execute this larger move.
<i>GO WAVE</i>	This key induces wavelength motion to a specified position. Press GO WAVE, then use the keypad to enter the desired wavelength, and finally press ENTER to execute the move.
<i>GRAT</i>	Press this key to move to the other grating position. Press GRAT, then press either 1 or 2 on the numeric keypad, and finally press ENTER to execute the change. The display will update to show the correct parameters for the new grating.
<i>SHIFT LABEL</i>	This key (located directly above GRAT) provides access to the grating label. The label is an eight character alpha-numeric field that is used for information only. Newport puts the grating blaze wavelength as the label during calibration. However, you can use the keypad to type any number, then press ENTER to accept that new value. The Hand Controller display only shows the first four digits of the label, and you can only enter numbers.
<i>LINES</i>	Press this key to change the lines/mm of the grating. This value is used for wavelength calculations and will affect your calibration. This parameter should be changed only when adding a new grating.
<i>SHIFT CALIB-</i>	This button is used to change the wavelength calibration of the current grating. Use the GO WAVE, STEP DOWN, and STEP UP keys to move to a known wavelength (often the intensity peak for a spectral calibration lamp). If the wavelength shown in the top row of the display does not match the known value, press SHIFT CALIB and use the numeric keypad to enter the known wavelength. Then press ENTER to change the calibration. The current grating is thus calibrated over its entire range.
<i>SHUTTER</i>	Alternately open and close the shutter by pressing this button. The shutter position is shown in the display as "OPN" for open and "CLS" for closed.
<i>SHIFT PORT</i>	not available for the Cornerstone 260™.
<i>FILTER</i>	Move the 74010 Filter Wheel accessory to the specified position. Press FILTER, then type the number 1, 2, 3, 4, 5, or 6 indicating the desired position, then finally press ENTER to execute the move.
<i>SHIFT LABEL</i>	This key (located directly above FILTER) provides access to the filter label. These labels are eight character alpha-numeric fields, used for information only. You can use the keypad to type any number, then press ENTER to accept that new value. The Hand Controller display only shows the first four digits of the label, and you can only enter numbers.

LOCAL	Use this key to toggle between “local” communication through the Hand Controller and “remote” communication with a computer. Please note that if you press LOCAL to activate the Hand Controller (the display is lit and information fills the screen), you also lock out PC communications. You cannot command the Cornerstone™ via either RS-232, IEEE-488 or USB while the Hand Controller is active.
SHIFT UNITS	To change the wavelength units press this key, followed by either 1, 2, or 3 and then press ENTER. Those three number keys are labeled with the corresponding units: 1 is nanometers (nm), 2 is micrometers (μm), and 3 is wave numbers (cm ⁻¹) shown as “□”.
1	Pressing the 1 key when not in a function parameter edit mode brings up the “ <i>Slit1um></i> ” prompt to edit/enter the slit 1 size, (the slit at the input port), the integer parameter is the open size specified in microns. Slit range is 6-2000 microns, in 6 micron resolution steps; for values larger than 2000 the slit goes to 2000, for values 0-6 the slit goes to 6.
SHIFT 1	Pressing the SHIFT-1 key when not in a function parameter edit mode brings up the “ <i>Bandpass></i> ” prompt. The floating point parameter is the wavelength resolution to automatically adjust slits for. If Bandpass is not set at zero the 74100 will be adjust all slits to maintain the Bandpass resolution at wavelength moves and grating changes. Setting Bandpass to 0 turns off this automatic adjustment. Slit range is 6-2000 microns, in 6 micron resolution steps. For Bandpass adjustments requiring slit openings larger than 2000 the slit goes to 2000, for values 0-6 the slit goes to 6. Note; for Bandpass slit size calculations to function properly, Slit1 must be at the input port.
2	Pressing the 2 key when not in a function parameter edit mode brings up the “ <i>Slit2um></i> ” prompt to edit/enter the slit 2 size, the integer parameter is the open size specified in microns. Slit range is 6-2000 microns, in 6 micron resolution steps; for values larger than 2000 the slit goes to 2000, for values 0-6 the slit goes to 6.
3	Pressing the 3 key when not in a function parameter edit mode brings up the “ <i>Slit3um></i> ” prompt to edit/enter the slit 3 size, the integer parameter is the open size specified in microns. Slit range is 6-2000 microns, in 6 micron resolution steps; for values larger than 2000 the slit goes to 2000, for values 0-6 the slit goes to 6.

IV.2. GETTING STARTED WITH IEEE-488

IEEE-488 communication (also called GPIB) offers the greatest versatility for integrating your Cornerstone™ into a larger system since you may connect up to 30 different devices to the same controller card. However, this versatility brings with it some complication in setting up each device.

Newport designs all of its IEEE-488 products to be completely compatible with National Instruments' GPIB controller cards. Likewise, most of our IEEE-488 software requires National Instruments' device drivers to run on your PC. We strongly recommend National Instruments' controller cards. Since there are differences between IEEE-488 implementations among the various manufactures, we cannot support them all. Therefore, Newport will only provide communication and software support for IEEE-488 systems that use National Instruments controller cards.

Physical Connections

First, install your National Instruments control card and software in your PC computer. Run their diagnostic tools to make sure the card is working properly.

Next, be sure the Cornerstone™ power switch is off, then attach your IEEE-488 cable to the appropriate connector on the back panel. Attach the other end to the National Instruments' control card and secure the screws on both sides. Now turn on the Cornerstone™. In order to limit possible address conflicts, we recommend that you turn off all other IEEE-488 instruments while checking your Cornerstone™ for the first time.

NOTE: The Cornerstone™ default GPIB primary address is 4.

Verify Communications

You can check your IEEE-488 communications by running the application Cornerstone Utility Program . See software installation (in section II. UNPACKING AND SETTING UP)

When this application runs, a dialog box will appear asking for the GPIB board index and Cornerstone™ 260 address. The default values, 0 and 4 respectively, should work for most systems. If you have multiple controller cards or if you have changed the Cornerstone™ 260 address fill in the correct values. Click the OK button to establish communication and open the main application window.

If you get an error at this point you may have a connection problem. Check all the cables (including the line cord), make sure the Cornerstone™ 260 is turned on, and make sure the Hand Controller is off. PLEASE NOTE: if the Hand Controller is active (the display is lit and information fills the screen), you cannot command the Cornerstone™ 260 via either RS-232 or IEEE-488. Press the LOCAL key on the Hand Controller to deactivate it, allowing PC communications. PLEASE ALSO NOTE: Cornerstone™ 260 selects either RS-232 or IEEE-488 communications based upon the first command received after power up. When you send an IEEE-488 command, or initialize your IEEE-488 software, the RS-232 link will be ignored until Cornerstone™ 260 power is turned off and on again.

Low Level Communications

It may be desirable to send commands directly to the Cornerstone™ 260 through the National Instruments Interactive Control or through another simple interface. To establish low level communications with Cornerstone™ 260 you will have to first open the device. Using the National Instruments' drivers the correct command is: **ibdev 0 4 0 13 0 0x140a**

The timeout code "13" allows 30 seconds to read responses back from Cornerstone™ 260. In most cases 300 ms is sufficient (timeout code 10), however, the longer period guarantees success on all commands. The end of string code "0x140a" terminates a read when the linefeed character is received from the instrument. All Cornerstone™ 260 responses end with carriage return and linefeed. Likewise, all messages sent to Cornerstone™ 260 must end with the linefeed character.

Again, refer to the detailed discussion of section V. FUNCTIONS AND CONTROLS for further information on direct low level communications, message syntax, and parameters.

IV.3. GETTING STARTED WITH RS-232 COMMUNICATIONS

RS-232 connections are a simple means of communicating between your PC and your instruments. However, you are limited in that each instrument must have its own dedicated communication port at the computer. Most PC's come standard with COM1 and COM2, although COM1 is occasionally used by a serial mouse. Additional communication port hardware can be added and the corresponding drivers must be added to your Windows™ software. Please review your computer setup to determine what physical connections are available to you. Again, due to the variety of hardware and software options that are available Newport cannot provide support for PC configuration.

Physical Connections

First, make sure that the COM port you would like to use for Cornerstone™ is recognized by Windows™ and is working properly. Usually a simple check can be done with a serial mouse.

Next, be sure the Cornerstone™ power switch is off, and then attach your RS-232 cable to the appropriate connector on the back panel. Attach the other end to the COM port connection on your PC. Note that RS-232 cables come in two types: modem and null-modem. The modem cable is a pin-to-pin cable. That is, each pin at one end connects directly to the corresponding pin at the other end: 1 to 1, 2 to 2, 3 to 3, etc. The modem cable is the correct cable for communicating with Cornerstone™.

Now turn on the Cornerstone™. You are ready to communicate with the instrument. The hardware communication parameters, including baud rate, are fixed inside Cornerstone™, so setup your COM port as follows:

Baud Rate:	9600
Data Bits:	8
Parity:	None
Stop Bits:	1
Flow Control:	None

Verify Communications

Check your RS-232 communications by running the Cornerstone Utility application. See software installation (in section II. UNPACKING AND SETTING UP).

When this application runs, a dialog box will appear asking for the COM port number. Fill in the correct value, then click the OK button to establish communication and open the main application window.

If you get an error at this point you may have a connection problem. Check all the cables (including the line cord), make sure the Cornerstone™ is turned on, and make sure the Hand Controller is off. PLEASE NOTE: if the Hand Controller is active (the display is lit and information fills the screen), you cannot command the Cornerstone™ via either RS-232 or IEEE-488. Press the LOCAL key on the Hand Controller to deactivate it, allowing PC communications. PLEASE ALSO NOTE: Cornerstone™ selects either RS-232 or IEEE-488 communications based upon the first command received after power up. When you send an RS-232 command, or initialize your RS-232 software, the IEEE-488 link will be ignored until Cornerstone™ power is turned off and on again.

Low Level Communications

In some cases, it may be desirable to send commands directly to Cornerstone™ through a terminal emulation program, such as the HyperTerminal™ provided with Windows™. Once your terminal program is open and running you will have to first select a COM port and configure it according to the parameters previously listed (9600, 8, N, 1, None). Additionally, you should set the terminal to "Send line ends with line feeds". There is no reason to turn on the local echo since Cornerstone™ will automatically echo each character as it is typed. All Cornerstone™ responses end with carriage return and linefeed. Likewise, all messages sent to Cornerstone™ must end with the linefeed character.

Again, refer to the detailed discussion of section V. FUNCTIONS AND CONTROLS for further information on direct low level communications, message syntax, and parameters.

IV.4. GETTING STARTED WITH USB COMMUNICATIONS

IMPORTANT: *Do not connect any USB Cornerstone™ to the computer unless the USB driver has been installed. Please read below.*

USB ("Universal Serial Bus") offers state-of-the-art connectivity which provides significant advantages over both RS-232 and GPIB communications for Cornerstone™ devices:

It is not necessary to know specific RS-232 port numbers to which monochromators are connected.

It is not necessary to configure GPIB addresses manually for each monochromator.

If multiple monochromators are connected to a single computer, they can be referenced easily by their serial numbers, thereby avoiding "addressing" issues which can occur with both RS-232 and GPIB models.

Physical Connections

USB requires proper installation of driver software for correct operation. If the Cornerstone™ 260 USB driver has not yet been installed, please read §II.1 through §II.3, (pp. 5–7) and do not connect the monochromators until instructed to do so.

Verify Communications

You can check your USB communications by running the application Cornerstone Utility Program. See software installation (in section II. UNPACKING AND SETTING UP)

If you get an error at this point you may have a connection problem. Check all the cables (including the line cord), make sure the Cornerstone™ 260 is powered on. If any cabling or power issues were identified, first correct the problems, then exit the Utility Program and launch it again.

Also, make sure the Hand Controller is off. PLEASE NOTE: if the Hand Controller is active (the display is lit and information fills the screen), you cannot command the Cornerstone™ 260 via USB. Press the LOCAL key on the Hand Controller to deactivate it, allowing PC communications.

Low Level Communications

Commands and queries are sent to the Cornerstone™ and responses are read via a DLL (dynamic-link library) whose functions are called from user application software (see §IV.4.1 below).

Also, refer to the detailed discussion of section V. FUNCTIONS AND CONTROLS for information on direct message syntax and parameters.

IV.4.1. USING THE CORNERSTONE™ USB DLL

The Cornerstone™ USB DLL "cs_USB.dll" is located in the \Cornerstone dll\USB driver folder on the Utility DVD. This file must be copied into a folder on the computer where it can be accessed, generally the same folder where the user software resides, although this depends on the programming language.

General Considerations

Before using the DLL, it is necessary to install the Microsoft Visual C++ 2008 runtime package. Run the executable program "vcredist_x86.exe" provided by Microsoft, located in the \Cornerstone dll\USB driver folder on the Utility DVD, and follow its installation wizard before proceeding.

Note: If compiled applications will be deployed on a computer other than the development system, the Visual C++ runtime package and all necessary DLL components must be installed on that system also. This document cannot address all issues involved therein.

The DLL provides basic I/O functionality only, and the sequence of operations for use is as follows:

Be sure that all devices are connected and powered on, as the DLL checks for available devices only when it is first loaded by a user application.

Call the "Open" function to establish connection to a Cornerstone™. If only a single monochromator is connected, the serial number argument can be passed as zero; otherwise provide the serial number of the desired device. If successful, this will return a non-negative "device ID" number used for further communications.

Repeat Step #0 for all devices which are to be controlled.

Call the "Write" function to send a command or query to a monochromator, passing its device ID as an argument.

If the command/query returns a response, call the "Read" function to retrieve the result, passing the device ID as an argument.

Repeat from Step #0 until the application should terminate.

Call the "Close" function once per opened device, passing its device ID as an argument.

If the result of any call indicates failure, call "GetLastError" immediately thereafter to fetch an error code (§IV.4.3, p. 18) to assist in troubleshooting. Note that GetLastError returns only *communications* errors, not monochromator *usage* errors.

Note: Function names cited above are *generic*. The DLL itself prefixes each function name with "cs_", but Newport provides application programming interface (API) "wrappers" for some common client development languages to facilitate rapid deployment, and these wrapper function names may vary slightly depending on the language used.

LabVIEW Clients

LabVIEW clients should use the provided API "wrapper" VIs, thus avoiding the difficult task of interfacing to the DLL directly.

Please examine the sample LabVIEW program "Cornerstone test.vi" located in the \Cornerstone dll\API\LabVIEW folder on the Utility DVD for a simple demonstration of DLL usage via the wrapper VIs.

Since LabVIEW provides for error handling via "error in/error out" terminals, it is not necessary for the user application to call "GetLastError" explicitly—this is done automatically by the wrapper VIs in the event of communications errors, and the "error out" cluster from each VI will return error code 6 ("Generic file I/O error") with the DLL error code in the error text.

Note: The “Cornerstone Write.vi” function will append a [lf] termination character (§V.1, p. 20, et seq.) to any command or query automatically, and the “Cornerstone Read.vi” function will strip the [cr][lf] termination characters from the end (*only*) of any response to facilitate LabVIEW string handling.

Also included is a convenience function (“Cornerstone Write and Read.vi”) which combines both a Write and Read operation into a single VI to conserve block diagram space. Use this VI only if the command/query returns a result, otherwise a timeout error will occur.

LabVIEW clients require that only the “cs_USB.dll” file be in a path available to the application.

Visual Basic Clients

Visual Basic clients should incorporate the “cs_USB.bas” module into projects, thus avoiding the difficult task of interfacing to the DLL directly (especially for functions returning C-style strings, which require explicit and tedious marshaling to convert their results to Visual Basic-style strings).

Please examine the sample VB project “Cornerstone test.vbp” located in the \Cornerstone dll\API\VB folder on the Utility DVD for a simple demonstration of DLL usage via the module.

Note: VB clients must check for errors manually.

VB clients require that only the “cs_USB.dll” file be in a path available to the application.

MATLAB Clients

Since MATLAB provides inherent marshaling of arguments and return values for a DLL, no “wrapper” functions are needed.

Please examine the sample MATLAB code for a simple demonstration of DLL usage.

Note: MATLAB clients must check for errors manually.

MATLAB clients require that both the “cs_USB.dll” and “cs_USB.h” files be in a path available to the application.

Direct DLL Clients

All other client languages must call DLL functions directly. While the exact mechanisms to do such are beyond the scope of this document, some general guidelines follow.

The DLL is written in Microsoft Visual C++, but all exported functions have undecorated names (i.e., declared as *extern “C”*), and use `__stdcall` (WINAPI) calling convention. Please refer to the header file “cs_USB.h” for prototypes.

The file “cs_USB.lib” is provided for clients who may need to utilize “early” (i.e., compile-time) binding to a DLL. All exported functions have their ordinals specified explicitly by a definition file (rather than using the `__declspec(dllexport)` directive), so future DLL releases should not cause upgrade problems.

Note: Direct DLL clients must check for errors manually.

In general, direct DLL clients require that only the “cs_USB.dll” file be in a path available to the application.

IV.4.2. CORNERSTONE™ USB DLL REFERENCE

This section describes the DLL calls in detail.

int cs_Open (unsigned long serialNo)

Opens the monochromator specified by its serial number. If only one device is attached to the system, the serial number can be specified as zero.

Returns an integer device ID used by subsequent DLL calls. If this value is negative, the operation failed.

long cs_Close (int deviceID)

Closes the monochromator specified by its device ID.

Returns a "success" flag: non-zero if successful; zero if the operation failed.

long cs_Write (int deviceID, char* statement)

Writes a statement (command or query) to the monochromator specified by its device ID.

Returns a "success" flag: non-zero if successful; zero if the operation failed.

char* cs_Read (int deviceID)

Reads a response from the monochromator specified by its device ID.

Returns a pointer to the null-terminated text. If the return string is empty, the operation failed.

Note: This function will block the calling process if the monochromator is busy executing a command. If no response is generated within 30 seconds after the last "cs_Write" call, a timeout error occurs. See also "cs_ReadNowait" below.

char* cs_ReadNowait (int deviceID)

This function is identical to the "cs_Read" function, but does not block the calling process if no response has yet been generated.

If the return string is empty, call "cs_GetLastError" to determine the reason for failure. If this returns error code 21 (ERROR_NOT_READY), then the response is not yet ready and the read should be attempted again later.

If no response is generated within 30 seconds after the last "cs_Write" call, a timeout error still occurs.

Note: To avoid excessive CPU load, this function will delay internally for 50 milliseconds before returning if no response is available.

long cs_GetLastError (void)

Returns a numeric value for the last communications error encountered by the DLL. See §IV.4.3., for a list of the most common error codes.

Note: This function should be called immediately after any other DLL function indicates failure to prevent the saved error code from being overwritten by other calls. Calling this function will also reset the saved error value to zero ("no error").

char* cs_GetDLLVersion (void)

Returns a pointer to a null-terminated DLL version string (e.g., "cs_USB.dll: Version 0.5\r\n").

This function succeeds always.

void cs_RescanBus (void)

This function is currently reserved.

IV.4.3. CORNERSTONE™ USB DLL ERROR CODES

This section describes the most common error codes which may be returned by the "cs_GetLastError" DLL function. (All numeric values are Windows codes defined in winerror.h.)

DLL calls generate errors only for DLL and USB communications issues and not incorrect usage of the monochromator command set per se. To test for usage errors, use the "STB?" and "ERROR?" queries (see §V.4, p. 27).

Calling "cs_GetLastError" returns only the last saved error code for the calling process, so it is recommended to test for any error condition indicated by a DLL function's return value and, if appropriate, call "cs_GetLastError" before issuing any further DLL calls. *Failure to do so may result in the original error code being overwritten before it is fetched, and will make troubleshooting difficult.*

Calling cs_GetLastError will reset the last saved error code to zero ("no error") always, so the calling process has only one chance to catch any saved error.

Error codes are listed in numerical order:

- 6 (ERROR_INVALID_HANDLE): This error usually indicates an attempt to open a monochromator which has been opened already, or that another process tried to access the same monochromator.

Note: The DLL does not currently maintain "ownership rights" for each device, and relies on client software to be well-behaved in this respect.
- 13 (ERROR_INVALID_DATA): This error should result only from the cs_Write call and indicates that a null pointer was passed as the statement argument.
- 20 (ERROR_BAD_UNIT): This error's cause depends upon the precipitating function call:
 - cs_Open: The monochromator referenced by an explicit serial number is offline; or, if serial number was passed as zero, no monochromators are online.
 - Other calls: The device ID supplied as an argument to the call references a non-existent monochromator.
- 21 (ERROR_NOT_READY): This error should result only from the cs_ReadNowait call and

indicates that the monochromator's response to the last statement issued is not yet available, and the function should be called again later—see also 1460 (ERROR_TIMEOUT).

- 87 (ERROR_INVALID_PARAMETER): An invalid or out-of-range device ID was supplied as an argument to a call.
- 1460 (ERROR_TIMEOUT): This error should result only from the cs_Read or cs_ReadNowait calls and indicates that the read did not return any data within 30 seconds since the last write was issued.
- 1784 (ERROR_INVALID_USER_BUFFER): This error should result only from the cs_Write call and indicates that the statement argument was passed as empty or too long.

Any other error codes, or those listed above which occur under other than noted circumstances, may be caused by an internal DLL error or incorrect usage of its interface—please contact Newport/Oriel Customer Support.

V. FUNCTIONS AND CONTROLS

V.1. COMMAND AND QUERY SYNTAX

For the purposes of this discussion we will divide communications with the instrument into two parts. First, the messages that you send to Cornerstone™ will be called "Statements". Second, the messages that you receive from Cornerstone™ will be called "Responses". When communicating with Cornerstone™ you will use two types of Statements: "Commands" and "Queries". A Command causes some physical action or sets an internal parameter. Queries ask some question of the instrument and automatically return a Response. Fundamentally, the syntax is the same for all messages.

Termination

Both Statements and Responses end with a carriage return (ASCII character code 13 decimal) and linefeed (ASCII character code 10 decimal). This manual will show the termination as [cr][lf]. Please note, you may find it more convenient to end Statements with only the linefeed [lf]; this is also acceptable.

Capitalization

Statements may be sent in upper case, in lower case, or in any combination of the two. Responses will always be returned in upper case. For clarity throughout this manual, Statements will be shown in upper case (ie. STATEMENT) and Responses will be shown in upper case italics (ie. *RESPONSE*).

Parameters

Some Statements will require a parameter. In this manual numeric parameters will be shown as "XX"; each X will fill a numeric position and decimals are used to indicate where floating point number should be expected. Numeric notation is not strict and integers can be substituted for floating point numbers as desired. There are some specific cases where alpha-numeric values or exponential notation may be required; these special Statements will be detailed in the sections that follow.

V.1.1. STANDARD MODE

Most normal communication with Cornerstone™, especially communication handled inside closed application software, is done in Standard Mode. This mode follows all of the rules on the previous page plus there are some additional features for error handling.

Cornerstone™ stores errors internally in a status byte and an error byte, where each bit has a specific meaning. Details of the status and error bytes can be found in this manual under section V-4 ERROR CODES. For now, we will simply cover the syntax necessary to send Statements and receive Responses in this communication mode.

In all cases, Statements must be terminated properly with [lf] for Cornerstone™ to take any action. Statements that are not understood or parameters that are unacceptable will generate an error code in the status byte, ie. status byte not equal to 0. Moreover, the status byte must be explicitly read, it is not returned after general Statements. Correct Statements are handled as follows:

Commands

Under RS-232, Statements are echoed back to the PC. Thus, after sending a Command you should read back this echo. There is no further response to a Command.

For example:

Send: GOWAVE 500[lf]

Response: GOWAVE 500[lf]

Under IEEE-488 and USB, there is no echo. There is no automatic response to a Command.
For example: Send: GOWAVE 500[lf] Response: {none}

Queries

Under RS-232, Statements are echoed back to the PC. Additionally, there will be an explicit response to that query. Thus, after sending a Query you should read back the echo and the answer together.

For example: Send : WAVE?[lf] Response: WAVE?[lf]500[cr][lf]

Under IEEE-488 and USB, there is no echo. Thus, you can read back the Response by itself.

For example: Send : WAVE?[lf] Response: 500[cr][lf]

V.1.2. HANDSHAKING MODE

This communications mode is most useful for methods development, troubleshooting, or in the early stages of programming. Use the command: "HANDSHAKE 1[lf]" to put Cornerstone™ into Handshake Mode. This mode follows the command syntax listed at the start of section V-1 in this manual, but in addition every Statement is acknowledged. The "handshake" that you receive is the status byte.

Cornerstone™ stores errors internally in a status byte and an error byte, where each bit has a specific meaning. Details of the status and error bytes can be found in this manual under section V-4 ERROR CODES. For now, we will simply cover the syntax necessary to send Statements and receive Responses.

In all cases, Statements must be terminated properly with [lf] for Cornerstone™ to take any action. Statements that are not understood or parameters that are unacceptable will generate an error code in the status byte, ie. status byte 0.

This status byte will be reported immediately if it contains an error, otherwise the status byte "00" will be returned upon completion of the Statement. Correct Statements are handled as follows:

Commands

Under RS-232, Statements are echoed back to the PC. Thus, after sending a Command you should read back this echo. Additionally, the status byte is reported when the action is complete.

For example: Send: GOWAVE 500[lf] Response: GOWAVE 500[lf]00[cr][lf]

Under IEEE-488 and USB, there is no echo. The only response will be the status byte.

For example: Send: GOWAVE 500[lf] Response: 00[cr][lf]

Queries

Under RS-232, Statements are echoed back to the PC. Additionally, there will be an explicit response to that query, and the status byte. Thus, after sending a Query you should read back a 3 part answer.

For example: Send : WAVE?[lf] Response: WAVE?[lf]500[cr][lf]00[cr][lf]

Under IEEE-488 and USB, there is no echo. Thus, you will read back the Response and the status byte.

For example: Send : WAVE?[lf] Response: 500[cr][lf]00[cr][lf]

V.2. BRIEF COMMAND REFERENCE

Command Quer	y	Hand Ctrl Key
ABORT		[ABORT]
ADDRESS XX	ADDRESS?	
CALIBRATE XXX.XXX		[CALIB]
	ERROR?	
FILTER X	FILTER?	[FILTER]
FILTER1LABEL TTTTTTTT	FILTER1LABEL?	[SHIFT LABEL]
GOWAVE XXX.XXX	WAVE?	[GO WAVE]
GRAT X	GRAT?	[GRAT]
GRAT1FACTOR XXX.XXX	GRAT1FACTOR?	
GRAT1LABEL TTTTTTTT	GRAT1LABEL?	[SHIFT LABEL]
GRAT1LINES XXXX	GRAT1LINES?	[LINES]
GRAT1OFFSET XXX.XXX	GRAT1OFFSET?	
HANDSHAKE X	HANDSHAKE?	
INFO?		[LOCAL]
SHUTTER T	SHUTTER?	[SHUTTER]
	STB?	
STEP XXX	STEP?	[STEP UP]
UNITS TT		[SHIFT UNITS]
SLIT1MICRONS XXXX	SLIT1MICRONS?	[1]
SLIT2MICRONS XXXX	SLIT2MICRONS?	[2]
SLIT3MICRONS XXXX	SLIT3MICRONS?	[3]
BANDPASS XXX.XX	BANDPASS?	[SHIFT 1]
OUTPORT X	OUTPORT?	PORT

V.3. DETAILED COMMAND REFERENCE ORGANIZED BY FUNCTION

Recall from section V-1 of this manual that messages that you send to Cornerstone™ will be called "Statements" and messages that you receive from Cornerstone™ will be called "Responses". There are two types of Statements: "Commands" and "Queries". A Command causes some physical action or sets an internal parameter. Queries ask some question of the instrument and automatically return a Response. Also recall that all Statements must end in [lf], and [cr][lf] is acceptable. Likewise, all Responses will end with [cr][lf]. Refer to section V-1 for detailed general syntax instructions. This section describes the exact syntax, acceptable parameters, and functionality for every Cornerstone™ Command. For each corresponding Query, in braces {}, we also list the type of Response you should expect. Where appropriate the corresponding Hand Controller key, in brackets [], is also listed. Finally, there are some warnings as to possible errors that could occur if a command is not used properly.

Cornerstone™ Motion Commands:

UNITS TT {UNITS?} [UNITS]
Specifies the operational units designated by the mnemonic parameter "TT". Possible parameters are:

"NM" for nanometers "UM" for micrometers "WN" for wavenumbers (cm⁻¹)

By default Cornerstone™ uses nanometers. Parameters for all motion Statements are handled in the current units. Therefore, if you change from nanometers to micrometers GOWAVE parameter must be entered in micrometers. Likewise, WAVE? answers will be returned in micrometers. The response to UNITS? is always the two character mnemonic for the current units.

GOWAVE XXX.XXX {WAVE?} [GO WAVE]
Moves the wavelength drive at maximum speed to the step position closest to the specified wavelength parameter. This parameter must be in the current units and may be either a floating point number or an integer, ie. "GOWAVE 500.00[lf]" and "GOWAVE 500[lf]" will be understood the same way. For each grating there is a maximum possible wavelength (approximately 1600 nm for a 1200 l/mm grating, thus 800 nm for a 600 l/mm, etc.) This command will generate an error if the parameter is larger than the maximum wavelength. The response to WAVE? will be a floating point number indicating the exact wavelength position. Current units are assumed and so no units are passed with the floating point number.

CALIBRATE XXX.XXX [CALIB]
This command is used to make minor corrections to the wavelength calibration of Cornerstone™. It is used when installing new gratings, or at any point when the wavelength calibration is disrupted. Execute this command to define the current position as the wavelength specified in the numeric parameter XXX.XXX. Calculates a new OFFSET for the grating and saves it accordingly. A calibration procedure is outlined in Section VII-4 ADDITIONAL GRATINGS- WAVELENGTH CALIBRATION.

ABORT [ABORT]
Simply stops any wavelength motion immediately, ie. GOSCAN, GOWAVE, STEP, etc.

STEP XXXX {STEP?} [STEP UP] / [STEP DOWN]
Move the wavelength drive by the integer number of steps indicated in XXXX. The parameter can be positive or negative, however, one step is the smallest increment Cornerstone™ can move and so this parameter must be an integer. The response to STEP? is the current step position as measured from the physical home sensors.

automatically changed via the CALIBRATE command. A calibration procedure is outlined in Section VII-4
ADDITIONAL GRATINGS- WAVELENGTH CALIBRATION.

GRAT2OFFSET XXX.XXX {GRAT2OFFSET?}

Sets the calibration offset for grating #1 as the floating point parameter specified in XXX.XXX. Warning: this value is used to calculate wavelength motion. Offset is usually changed only when installing a new grating, and in that case the parameter should match the value provided by Newport. This value is automatically changed via the CALIBRATE command. A calibration procedure is outlined in Section VII-4
ADDITIONAL GRATINGS- WAVELENGTH CALIBRATION.

Cornerstone™ Accessory Commands:

SHUTTER T {SHUTTER?} [SHUTTER]

Closes or opens the shutter depending upon the single letter mnemonic parameter (T). Closing the shutter requires "C", whereas opening it requires "O". The response to SHUTTER? is simply the one character parameter describing the current state. When using the Hand Controller key [SHUTTER] no parameter is necessary. Pressing this key toggles the shutter out of the current state into the other state. Look to the display to check shutter position.

FILTER X {FILTER?} [FILTER]

Moves the filter wheel to the position specified in the single integer parameter "X". Acceptable values range from 1 through 6. The response to FILTER? is the integer value describing the current filter position; if there is no filter wheel connected, or if the wheel is out of position, "0" is returned and an error is set in the status byte. Sending this command while the filter wheel is out of position will cause the wheel to search for #1 and then move to the requested position. This search occurs at power on too.

FILTER#LABEL TTTTTTTT {FILTER#LABEL?} [SHIFT LABEL]

Sets the label for the filter position specified by # to the < 9 character string parameter "TTTTTTTT". Valid values of # are 1-6, using any other value will result in a status byte error indicating a bad command, not a bad parameter. The value of "TTTTTTTT" can be letters or numbers. This label is for informational purposes only.

SLIT1MICRONS XXXX {SLIT1MICRONS?} [1]

Commands the 74100 to open slit 1, (the slit at the input port), to the size specified by the integer parameter in microns. Slit range is 6-2000 microns, in 6 micron resolution steps; for values larger than 2000 the slit goes to 2000, for values 0-6 the slit goes to 6. If the query responds with 0, there is a problem with the slit.

SLIT2MICRONS XXXX {SLIT2?MICRONS} [2]

Commands the 74100 to open slit 2 to the size specified by the integer parameter in microns. Slit range is 6-2000 microns, in 6 micron resolution steps; for values larger than 2000 the slit goes to 2000, for values 0-6 the slit goes to 6. If the query responds with 0, there is a problem with the slit.

SLIT3 XXXX {SLIT3?} [3]

Commands the 74100 to open slit 3 to the size specified by the integer parameter in microns. Slit range is 6-2000 microns, in 6 micron resolution steps; for values larger than 2000 the slit goes to 2000, for values 0-6 the slit goes to 6. If the query responds with 0, there is a problem with the slit.

BANDPASS XXX.XX {BANDPASS?} [SHIFT 1]

The 74100 uses the Bandpass parameter to automatically adjust all the slits. The floating point parameter is the wavelength resolution to automatically adjust slits for. If Bandpass is not set at zero the 74100 will be adjust all slits to maintain the Bandpass resolution at wavelength moves and grating changes. Setting Bandpass to 0 turns off this automatic adjustment. Slit range is 6-2000 microns, in 6 micron resolution steps. For Bandpass adjustments requiring slit openings larger than 2000 the slit goes to 2000, for values 0-6 the slit goes to 6. Note; for Bandpass slit size calculations to function properly, Slit1 must be at the input port.

OUTPORT X

The 74100 uses the Outport 1 command to go to AXIAL PORT and Outport 2 to go to LATERAL PORT.

Cornerstone™ System Commands:

{INFO?} [LOCAL]

Query for basic instrument information. Generates the same response as the GPIB specific *IDN? That response is "Oriel, Model 74100 Cornerstone 260, SNXXX, VYY.YY.YY" where XXX is the unit's serial number and YY.YY.YY is the version number for internal firmware. This information is displayed for 3 seconds when [LOCAL] is pressed on the Hand Controller.

HANDSHAKE X {HANDSHAKE?}

This command turns Handshake Mode on and off. Setting the parameter "X" to "1" causes Cornerstone™ to acknowledge command completion according to the description given in

Section V-1-B. HANDSHAKE MODE. Setting the parameter to "0" returns Cornerstone™ to normal operation according to the description given in Section V-1-A STANDARD MODE. The response to the query HANDSHAKE? is the single integer describing the current mode, "0" or "1".

{STB?}

Use this query to check for Cornerstone™ error conditions. The response will be "32" when an error occurred or "00" when no error is present. Reading this code clears the status byte. Further information can be obtained using the ERROR? query below. A detailed discussion of error handling is given in section V-4.

{ERROR?}

Use this query to obtain further information about an error state reported in the Status byte. The response will be an integer from 0 through 9. The definition of each error code and a detailed discussion of error handling is given in section V-4.

ADDRESS XX {ADDRESS?}

Use this command to change the IEEE-488 primary address for Cornerstone™ if the default address (4) conflicts with another instrument in your laboratory. You should turn off the other instrument, establish communication with Cornerstone™, and send this command with the integer parameter from 1 to 30. If successful, the address change takes place immediately and any further communication using the old address will cause a IEEE-488 error. If unsuccessful an error will be reported in the Status byte.

V.4. ERROR CODES WITH DESCRIPTIONS

Cornerstone™ errors are stored internally in the Status byte and Error code. The Status byte is usually empty (decimal value 0) but if an error condition occurs, bit 5 of the Status byte will be set (decimal value 32). By checking this byte all error conditions can be checked at once. Further information is provided in the individual error codes. There is a detailed list of error codes later in this section. There are two ways to check for errors. First, you can explicitly query the Status Byte. This method is used for most communication and programming and is described in Section V-1-A STANDARD MODE. Use the query "STB?" to get the decimal value of the Status Byte, either "00" for success or non zero for error. If the response is not a zero then you should check the code for that particular error using the query "ERROR?". Please note that reading the Status Byte and the Error Code resets them back to "0".

You can also check errors immediately in Handshake Mode. Turn this mode on with the command "HANDSHAKE 1[lf]". Handshaking causes Cornerstone™ to respond to every Statement with the Status byte. The exact syntax is discussed in Section V-1-B HANDSHAKING MODE. Again, if the response is "20" then you should check the code for that particular error using the query "ERROR?". Likewise, the Status Byte is cleared after it is reported as the handshake.

Read Status Byte with: STB? 00 indicates no error

20 indicates error condition.

Read Error Code with: ERROR? Error codes are listed below.

Error code	Condition
1	Command not understood.
2	Bad parameter used in Command.
3	Destination position for wavelength motion not allowed.
6	Accessory not present (usually filter wheel).
7	Accessory already in specified position.
8	Could not home wavelength drive.
9	Label too long.
0	System error (miscellaneous).

VI. CORNERSTONE™ UTILITY PROGRAM

Cornerstone™ 260 software is loaded onto your PC per the directions in Section II UNPACKING AND SETTING UP. The Utility Program comes with three versions: IEEE-488, RS-232 and USB communications. This program provides easy access to most of Cornerstone™'s functions. It is especially useful for adding new gratings to your instrument; follow the instructions in Section VII-4 ADDITIONAL GRATINGS - WAVELENGTH CALIBRATION to add new gratings.

Main Window (Refer to Figure 1, Page 29)

The "Present Wavelength" indicates the wavelength position of the monochromator. All the wavelength units indicators on the Utility program's main screen are determined by the setting the Units Dialog Box.

The VCR type buttons under the "Present Wavelength" field can be used to position the monochromator by steps; reverse slew, back one step, stop, forward step, and fast forward.

The numeric control beneath the step motion buttons is used to position the monochromator by wavelength; enter the desired wavelength position and click on the "GoTo" button.

The Shutter status indicator is "Shutter Open"/"Shutter Closed."

The "Grating" indicator shows the active grating and its lines/mm.

The "Filter" indicator shows the present filter wheel position.

The "Scan Parameters" section enables the user to edit scan range, interval and time for the "Go Scan" button.

"Start Wavelength"	scan to begin at this wavelength
"End Wavelength"	scan to end at this wavelength
"Interval Wavelength"	scan to pause at interval wavelength points
"Pause"	seconds to wait at each scan point

Clicking "Go Scan" will run a monochromator scan according to the "Scan Parameters"

The buttons on the right side of the Utility Program's main window will bring up dialog boxes for different functions:

"Units"	Used to select the monochromator wavelength units, nanometers, micrometers or wave numbers.
"Calibrate"	Bring up a dialog to allow the user to calibrate the monochromator by entering the actual wavelength position.
"Setup"	Allows the editing/display of the monochromator's grating parameters, should never be needed unless installing new gratings.
"Shutter"	Allows control of the shutter.
"Grating"	Allows selection of a specific grating, or enables automatic grating selection for specific wavelength regions.

- "Filter" Allows selection of a specific filter wheel position, or enables automatic filter position for specific wavelength regions.
- "Setup Comm" Used to select IEEE-488 or RS-232 communication parameters, i.e. board address or port number. Not needed for USB (74125).
- "Exit" Exits the utility program and saves monochromator and communication parameters.

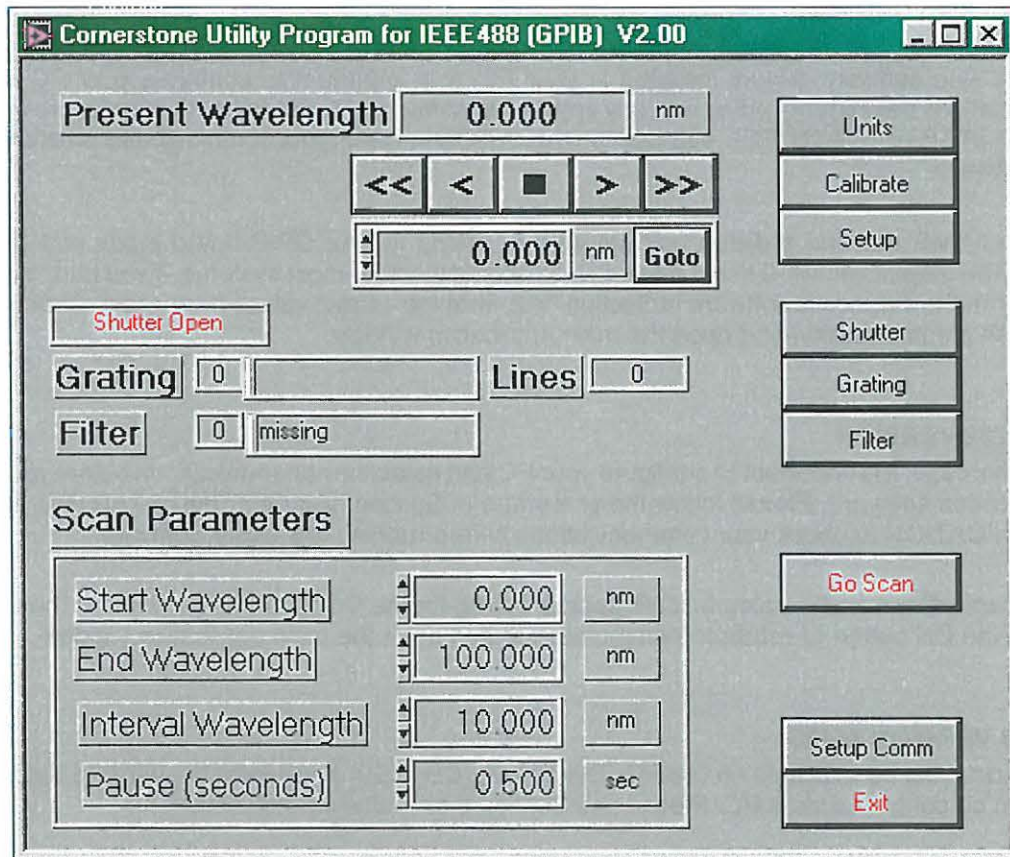


Figure 1 Cornerstone™ 260 Utility Program, Main Window

VI.1. SOURCE CODE

This program is a closed executable file written in National Instrument's LabView™ and is based on our collection of Cornerstone™ VI's. The Utility Program diagram may serve as an example or starting point for further development in LabView™. If you are a LabView™ programmer and own a full LabView™ development environment, you can load the VI's from your hard drive. There are three versions of the VI's, one each for RS-232, IEEE-488 and USB. See in Section II Table I for the location of the VIs on the CD.

VI.2. IEEE-488 VERSION

This version of the Utility Program requires that you have a National Instrument's IEEE-488 Controller Card and associated software drivers installed in your PC. It is important to configure your PC and establish communications before proceeding with any application software. Please follow the procedure in Section IV-2 GETTING STARTED WITH IEEE-488 COMMUNICATION to check your communications before running this Utility Software.

The program will run and a dialog box will appear asking for the GPIB board index and Cornerstone™ address. The default values, 0 and 4 respectively, should work for most systems. If you had to change these values to run the diagnostic software in Section IV-2, fill in the correct values here again. Click the OK button to establish communication and open the main application window.

VI.3. RS-232 VERSION

Again in this case, it is important to configure your PC and establish communications before proceeding with any application software. Please follow the procedure in Section IV-3 GETTING STARTED WITH RS-232 COMMUNICATION to check your communications before running this Utility Software.

The program will run and a dialog box will appear asking for the COM port number. Fill in the correct value, then click the OK button to establish communication and open the main application window.

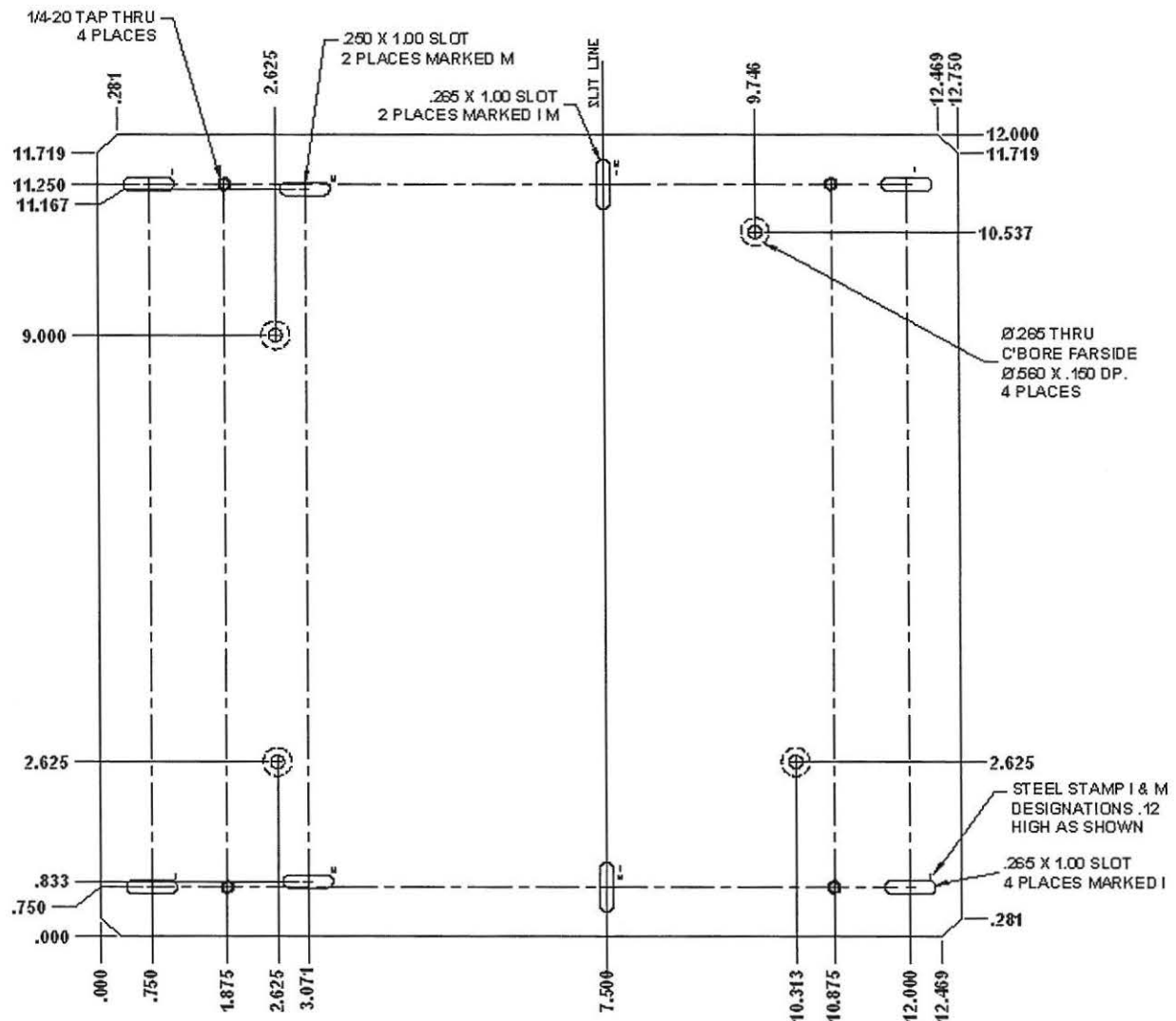
VI.4. USB VERSION 74125

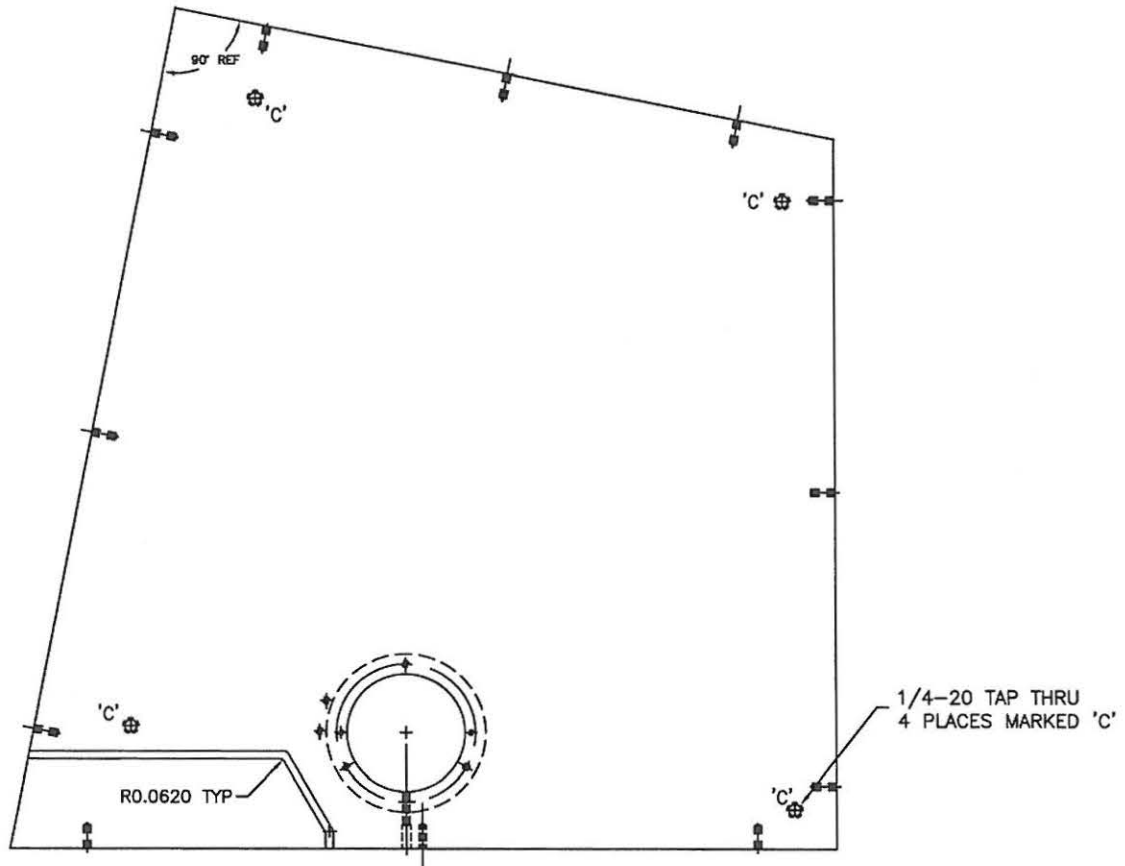
A USB2 port must be available on the PC. The ORIEL_CS_USB driver must be installed before the 74125 can be controlled via a PC. Please see Section II on Software Installation.

VII. OPTIONAL ACCESSORIES

VII.1. MOUNTING PLATE

Oriel's model 74105 Cornerstone™ Mounting Plate can be used to attach the instrument to an optical table, elevate it on rods, or establish easy alignment to the optical axis. The Cornerstone™ 260 mounts to this plate using the four 6-32 screws provided. Before attaching this plate, remove four set-screws (marked 'C' in the drawing on page 32) in the bottom of the monochromator.





Remove set-screws marked 'C' in the above drawing and mount the monochromator to the base plate.

VII.3. FILTER WHEEL

Oriel's model 74010 Motorized Filter Wheel is matched for use with Cornerstone™. The drive electronics and command set for this wheel are included with every Cornerstone™ and the wheel mounts directly to the monochromator via Newport's standard 1.5" Series Flange. The 74010 is a six position enclosed wheel that holds 1 inch (25 mm) diameter filters, with a clear aperture of 0.8 inches (20 mm). Each filter is mounted in it's own holder and the holders are individually removable. Moreover, in most cases, when you change a filter, there is no need to break you optical path since the filters holders can be exchanged from the side of the wheel. Filter holder is screwed into the filter wheel. If your optical system setup prevents the access to the side cover of the filter wheel, then make sure you install all the filters prior to your system assembly.

Note: None of the Cornerstone™ accessories are designed to be connected or disconnected with power on. Always turn off the instrument using the power switch on the back panel before you connect or remove the filter wheel.

Note: Make sure all six filter holders are installed even if you are not using all six filters. This is necessary for proper balance of the filter wheel.

6 position Motorized Filter Wheel	Model 74010
Rod Mount for 74011 Holders	Model 74012

VII.4. MOTORIZED SLITS

The motorized slit board supports up to three slits, only a max of two are needed for the 74100

At power up each slit will be homed by closing completely then opening to its previous position.

Slit 1 is at the input port, Slit 2 is the output port.

Slit Range	6-2000 microns
Slit Step Resolution	6 microns

VII.5. ADDITIONAL GRATINGS- WAVELENGTH CALIBRATION

Most Cornerstone™ 260 Monochromators are shipped with two gratings installed. However, these gratings are individually replaceable. That is, a single grating can be removed and a new one mounted in its place at your laboratory. There is no need to purchase more than one grating or a larger grating turret, and there is no need to send the instrument back to Newport. We offer a wide variety of gratings to suit most spectral ranges and resolution requirements. Please call Newport with your specific needs.

Installation

Each grating comes mounted and aligned on a completely adjustable grating mount. For most applications there is no need to adjust this grating holder. Simply follow the steps below to mount your new grating:

1. Using the Hand Controller, or directly from the PC, open the shutter and command Cornerstone™ to go to grating #1. Then send the instrument to zero order. (GOWAVE 0). At GOWAVE 0 the grating acts as a full reflector so all the incoming light should be reflected.
2. Turn off the power switch and unplug the instrument.
3. Remove all ten screws from the cover and lift it off. (WARNING: the optics inside this instrument are coating to protect and enhance their reflectivity. This coating is extremely soft and easily damaged. Do not touch any of the optics. Do not attempt to clean any of the optics, except with a gentle stream of filtered dry nitrogen. Since accidents do happen, we recommend wearing powder free, latex gloves when working inside the optical compartment of any instrument.)
4. There are two long screws, one on each side of the gratings. Use a screwdriver in the slots located at the top of the screws to loosen them.
5. The grating that is facing the main mirror is grating #1, while the grating that faces the electronics compartment is grating #2. Only change one grating at a time. Decide which one you would like to remove, grab the sides of that grating holder with one hand, and firmly pull the grating up and out of the instrument. (Pull in a direction parallel to the grating face, not directly up.) Be careful not to remove the other grating; you may want to hold it in place using one finger from your other hand.
6. Uncover your new grating, and use that cover to protect the grating you have just removed.
7. Note that inside the instrument, extending up from the top of the brass gear where the grating sits, is a small aluminum pin. This pin will locate your new grating. You **must** push the grating mount up against the center boss.
8. Slide the new grating into the instrument, back to back and parallel with the other grating. The pin mentioned in step #7 should come up through the clearance hole in the bottom of the grating mount. Make sure that the grating mount sits flat on the brass gear.
9. If you are replacing both gratings, return to steps #5 - #8 for the second grating.
10. Now replace the long knurled screws that hold the gratings in place. It is best to alternate between the two screws, not to tighten one completely and then the other. The screws should line up parallel with the grating face. These screws do not require excessive pressure to hold the gratings in place, use only firm finger pressure to tighten them.
11. Replace the cover and secure all ten screws. Again, start all ten screws and then tighten each one a little at a time- do not completely tighten one and then start the next.

12. Plug in the power cable and turn on the power switch.
13. Run the Cornerstone™ Utility Program of your choice, either IEEE-488 or RS-232. If you have not run this software before, refer to the instructions in Section VI. CORNERSTONE UTILITY PROGRAM.
14. Once the software is running and you see the main window, press the 'Setup' button in the center of the control panel.
15. Now perform the Wavelength Calibration as outlined in the next section and enter you new grating parameters in the correct column.
16. Press 'OK'. Your grating is now installed and updated.

Grating Factor Calibration

1. Select a radiation source that has at least two narrow spectral lines in the wavelength region where you will be working.
2. The radiation from your line source should be focused on the entrance slit to fill the monochromator's f/3.7.
3. The focused beam should be parallel to Cornerstone™'s optical axis.
4. Command Cornerstone™ to move to the grating you would like to calibrate and then to a wavelength of your line source. Now use the STEP feature to move Cornerstone™ toward the signal peak for your source.
5. Notate the spectral line you first commanded to move to and the resultant wavelength position where you located the actual peak. See the tables below.
6. Command Cornerstone™ to move to a second wavelength of your line source. Now use the STEP feature to move Cornerstone™ toward the signal peak for your source.
7. Notate the spectral line you first commanded to move to and the resultant wavelength position where you located the actual peak. See the example tables below.
8. Using Factor equation below to calculate these parameters for your new grating.
9. Repeat for all gratings, Using the Utility software you can enter the FACTOR values into the Cornerstone via the "Setup" screen. The GRATINGn FACTOR commands can be used, VIs are also supplied for these commands. They cannot be entered directly via the Hand Controller

	Spectral Line	Observed Peak
Wavelength 1	L1	P1
Wavelength 2	L2	P2

$$\text{FACTOR} = |L1 - L2| / |P1 - P2|$$

Example:

	Spectral Line	Observed Peak
Wavelength 1	546	577
Wavelength 2	365	372

$$\text{FACTOR} = |577 - 365| / |577 - 372| = 181 / 205 = 0.8829268$$

Blank tables to notate your peak locations

GRATING1

	Spectral Line	Observed Peak
Wavelength 1		
Wavelength 2		

GRATING 1 FACTOR =

GRATING 2

	Spectral Line	Observed Peak
Wavelength 1		
Wavelength 2		

GRATING 2 FACTOR =

GRATING 3

	Spectral Line	Observed Peak
Wavelength 1		
Wavelength 2		

GRATING 3 FACTOR =

Wavelength Calibration

For the highest accuracies, it may be necessary under some circumstances to wavelength calibrate your Cornerstone™. We recommend using a low pressure spectral line lamp such as Oriel's model 6035 Mercury Lamp for this purpose, however you can use another line source such as a laboratory laser. Set up for this task is quite important. Follow these guidelines:

1. Select a radiation source that has at least one narrow spectral line in the wavelength region where you will be working.
2. The radiation from your line source should be focused on the entrance slit to fill the monochromator's f/3.7.
3. The focused beam should be parallel to Cornerstone™'s optical axis.

Once you have set up the known source and your detection system, wavelength calibration is quite simple. First, command Cornerstone™ to move to the grating you would like to calibrate (#1 or #2) and then to the wavelength of your line source. Second, use the STEP feature to move Cornerstone™ toward the signal peak for your source. Finally, when you have reached the maximum signal use the CALIBRATE feature (CALIB on the Hand Controller) to enter the exact wavelength of your spectral line. Cornerstone™ will recalculate it's motion to place that wavelength in the position you have specified, and it will correct all other wavelength positions as well. However, you may need to repeat this for the other grating, or if you add a new grating later.

GOWAVE command appears on page 16 of this manual.
STEP command appears on page 17 of this manual.
CALIBRATE command appears on page 16 of this manual.

VIII. TROUBLESHOOTING TIPS

This chapter suggests solutions to potential problems you may encounter when operating Cornerstone. This section will be periodically updated on our web site at "oriel.sales@newport.com". If you have a question that is not answered in either place, please call a Newport Applications Engineer for assistance.

VIII.1. MEMORY LOSS (LARGE WAVELENGTH CALIBRATION ERRORS)

- Symptoms: There are large errors in wavelength positioning of all gratings (maybe 100nm).
 The instrument lists all gratings as 1200 l/mm.
- Problem: The instrument memory has been cleared. This may be the result of a power failure or a spike on the mains. It may also result from electro-static discharge or other high field radiation in contact with, or very nearby, you instrument.
- Solution: You will have to reload the instrument parameters. All of the necessary values are included on the Cornerstone Calibration Parameters datasheet that came with your instrument. . Run the Utility Program. Click 'Setup' to open Cornerstone Setup dialog window. Enter correct values and exit setup using 'OK' button. Your Cornerstone memory should be restored now.

IX. DECLARATION OF CONFORMITY

Manufacturer's name: Newport Corp
Manufacturer's address: 150 Long Beach Boulevard
Stratford, CT 06615
USA

Declares that the product:

Product Name Cornerstone 260™ Monochromator

Model Number: 74100, 74125, 74050, 74055

conforms to the following Product
Specifications:

Safety: EN 61010-1: 1993 + A2/IEC 1010-1: 1990 + A1 +A2
EMC: EN 50081-1: 1992
EN 55022: 1994 / EN 55011: 1993 Class B
EN 50082-1: 1992
IEC 801-2:1991 / IEC 1000-4-2: 1995
ENV 50140: 1993 / EC 1000-4-3: 1995 / EN 61000-4-3: 1995
IEC 801-4: 1988 / IEC 1000-4-4: 1995

complies with the following
Directives:

- the EMC Directive 89/336/EEC
- the Low Voltage Directive 73/23/EEC

and, accordingly, carries the CE
mark.

Stratford, CT June, 1998



George Buzel
Director of Engineering

X. WARRANTY AND RETURNS

Newport warrants that all goods described in this manual (except consumables such as lamps, bulbs, filters, ellipses, etc.) shall be free from defects in material and workmanship. Such defects become apparent within the following period:

1. All products described here, except spare parts: one (1) year or 3000 hours of operation, whichever comes first, after delivery of the goods to the buyer.
2. Spare parts: ninety (90) days after delivery of goods to the buyer.

Newport's liability under this warranty is limited to the adjustment, repair and/or replacement of the defective part(s). During the above listed warranty period, Newport shall provide all materials to accomplish the repaired adjustment, repair or replacement. Newport shall provide the labor required during the above listed warranty period to adjust, repair and/or replace the defective goods at no cost to the buyer ONLY IF the defective goods are returned, freight prepaid, to a Newport designated facility. If goods are not returned to Newport, and the user chooses to have repairs made at their premises, Newport shall provide labor for field adjustment, repair and/or replacement at prevailing rates for field service, on a portal-to-portal basis.

Newport shall be relieved of all obligations and liability under this warranty of:

1. The user operates the device with any accessory, equipment or part not specifically approved or manufactured or specified by Newport unless buyer furnishes reasonable evidence that such installations were not the cause of the defect. This provision shall not apply to any accessory, equipment or part, which does not affect the safe operation of the device.
2. The goods are not operated or maintained in accordance with Newport's instructions and specifications.
3. The goods have been repaired, altered or modified by other than authorized Newport personnel.
4. Buyer does not return the defective goods, freight prepaid, to a Newport facility within the applicable warranty period.

IT IS EXPRESSLY AGREED THAT THIS WARRANTY SHALL REPLACE ALL WARRANTIES OF FITNESS AND MERCHANTABILITY. BUYER HEREBY WAIVES ALL OTHER WARRANTIES, GUARANTEES, CONDITIONS OR LIABILITIES, EXPRESSED OR IMPLIED, ARISING BY LAW OR OTHERWISE, WHETHER OR NOT OCCASIONED BY NEWPORT'S NEGLIGENCE.

This warranty shall not be extended, altered or varied except by a written document signed by both parties. If any portion of this agreement is invalidated, the remainder of the agreement shall remain in full force and effect.

CONSEQUENTIAL DAMAGES-

Newport shall not be responsible for consequential damages resulting from misfunctions or malfunctions of the goods described in this manual. Newport's total responsibility is limited to repairing or replacing the malfunctioning or malfunctioning goods under the terms and conditions of the above described warranty.

INSURANCE-

Persons receiving goods for demonstrations, demo loan, temporary use or in any manner in which title is not transferred from Newport, shall assume full responsibility for any and all damage while in their care, custody and control. If damage occurs, unrelated to the proper and warranted use and performance of the goods, recipient of the goods accepts full responsibility for restoring the goods to their condition upon original delivery, and for assuming all costs and charges.

RETURNS-

Before returning equipment to Newport for repair, please call the Customer Service Department at (203) 377-8282. Have your purchase order number available before calling Newport. The Customer Service Representative will give you a Return Material Authorization number (RMA). Having an RMA will shorten the time required for repair, because it ensures that your equipment will be properly processed. Write the RMA on the returned equipment's box. Equipment returned without a RMA may be rejected by the Newport Receiving Department. Equipment returned under warranty will be returned with no charge for the repair or shipping. Newport will notify you of any repairs not covered by the warranty, with the cost of the repair, before starting the work.

Please return equipment in the original (or equivalent) packaging. You will be responsible for damage incurred from inadequate packaging, if the original packaging is not used.

Include the cables, connector caps and antistatic materials sent and/or used with the equipment, so that Newport can verify correct operation of these accessories.